Life in the fast lane: air taxis

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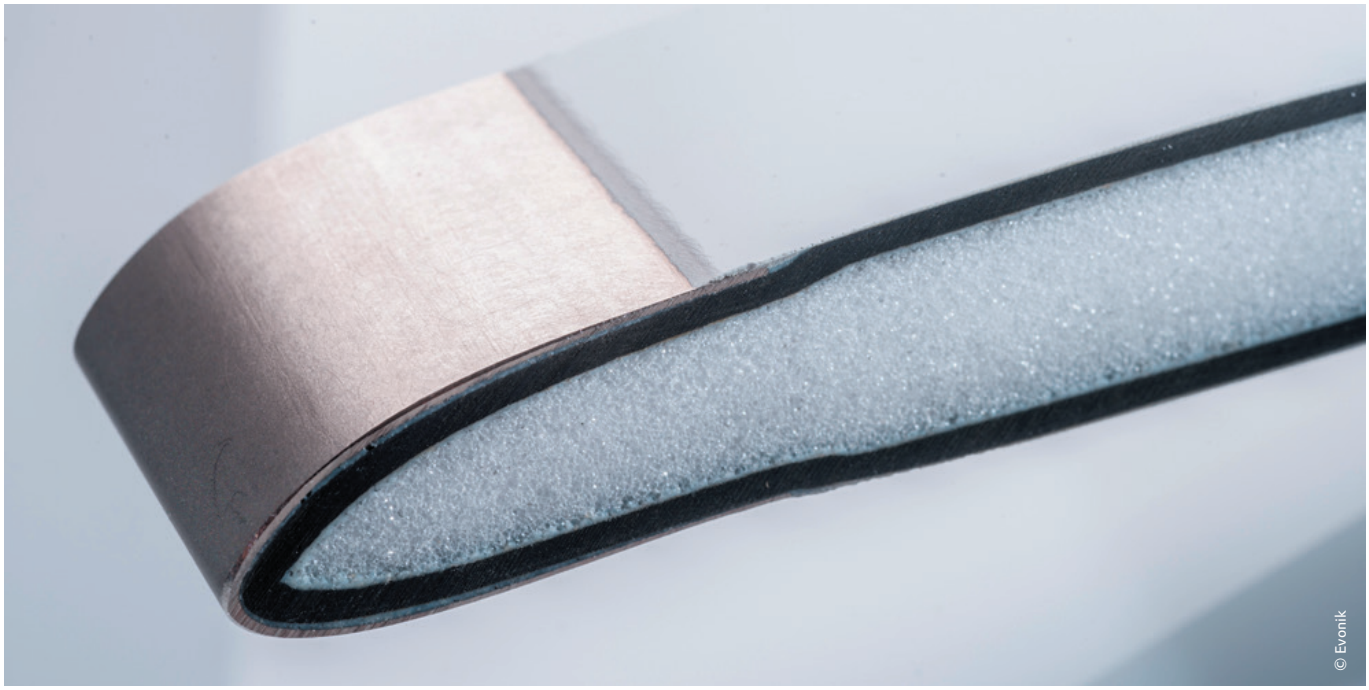
Manufacturers worldwide are working on eye-catching models for what will soon become the latest in public transportation – air taxis. Each incorporating different technologies, features and designs. But they all have one thing in common: a vehicle that is lightweight, energy-saving and robust. All at the same time. The proven strengths of ROHACELL® foam cores offer this emerging and exciting market a full collection of material solutions with the advantages it seeks.

No revolutionary innovation ever came completely out of nowhere. Engineers develop ideas that float in the air of creativity before they land in reality. It is only in the public consciousness that these new developments sometimes arrive late. The best example: Reports about air taxis are still very often introduced in the media with the remark that such means of transportation are "no longer science fiction". As if the journalists still have to convince themselves. The autonomous car, on the other hand, seems more a question of "when?" It is very possible that air taxis will be part of our daily lives even before fully autonomous vehicles. All over the world, models and prototypes are being developed, are making their maiden flights, and manufacturers around the world are reporting new milestones. Startups are collecting investment funds or are already entering into long-term cooperation agreements with potential users. The future is not just around the corner, it is already making its home in hangars and airports sporting a somewhat unwieldy official name: "Electric powered vertical takeoff and landing aircraft", eVTOL for short.

THERE IS STILL PLENTY OF ROOM IN THE AIRSPACE

There are reasons for the engineers' zeal and the high interest of investors, and these have to do with urbanization, mobility issues and with increasing freight traffic. "If everyone has a car, nothing moves," says Analli Carvalho, Business Development Manager for Air Taxis & Commercial Aviation at Performance Foams at Evonik. In London, Paris, New York, and St. Petersburg, people are already stuck in traffic jams for an average of 150 hours a year; in Bogota



and Rio de Janeiro, the figure is just under 200 hours a year. "So it's very logical to move passenger transport skyward - there's still plenty of room up there," says Carvalho. Particularly as increased congestion is projected: Delivery traffic has doubled in the past few years in many countries, partly due to online trading, and continues to grow in volume at an estimated 17 percent per year. The trend is continuing. Dr. Alexander Roth has an eye on all these factors as well as on the development of air taxis and all other new market trends and activities in the Aerospace Industry, because he leads the Aviation Transportation segment for Evonik's ROHACELL® Performance Foams business.

ROHACELL® foam is one of the accidental discoveries in the history of innovation. The structural foam made of polymethacrylimide, which was unexpectedly created during an experiment in the late 1960s, has some outstanding properties: it is extremely stiff, yet at the same time very lightweight and highly heat-resistant. In short: the ideal core material for composite parts. In a sandwich-design composite part, it can be easily bonded to carbon fiber facings, resulting in an extremely strong component that weighs much less than similar structural parts made of metal. "Such composites can then be processed without any problems at 180 °C (356 °F) and extremely high pressure, so they can be produced very quickly and efficiently - in this respect, ROHACELL® has huge advantages over other core materials," says Roth. That's why the polymethacrylimide foam has been used in lightweight construction applications worldwide for almost 50 years: found today in airplanes, helicopter rotor blades and drones. In other words: a material that seems to have been made for air taxis long before they existed.

THE RIGHT COMPOSITE MATERIALS DELIVER THE RIGHT PERFORMANCE

Each air taxi model must prove two things above all: That they can fly safely - and that they can achieve acceptable speeds and distance ranges. Experts estimate that the eVOTL aircraft should reach speeds of at least 100 to 150 kilometers per hour - otherwise it would hardly be possible to save time compared to other means of transport. Currently, most developers are planning cabins that accommodate between two and five passengers. And, of course, the air taxis should be able to fly far enough at full load capacity before needing to refuel or recharge. Less weight means less energy consumption - or more energy for faster speeds and longer distances. The right composite design and materials will be very crucial here: The solution is a lightweight sandwich structure with carbon fiber reinforced plastics on the outside and ROHACELL® as a structural foam core on the inside. In addition, there is the important issue of sustainability: The lighter the air taxi, the more we can support their argument for being energy-saving, sustainable alternatives in the transport mix of the future.

The combination of materials and the associated production costs become all the more important when it comes to complex components, complicated shapes or a wide range of force effects. This is where ROHACELL® is a stand-out material solution, since its high temperature resistance allows manufacturers to significantly reduce both production time and cost. It is also well-suited for use in efficient and precise automated production scenarios. The result is a lower-priced composite component, made of high-quality

"If everyone has a car, nothing moves. But there is still plenty of room in the air." Analli Carvalho

materials. "This applies, for example, to the passenger cabins of many air taxi models, which are intentionally designed to combine modern aesthetics with an aerodynamic profile," says Carvalho. "Or for doors or engine enclosures - wherever we are dealing with round, or more irregular geometric shapes".

VERSATILE APPLICATION POSSIBILITIES FOR AIR TAXIS

Manufacturers are pursuing very different technical approaches and very different designs. The "VoloCity" from the German company Volocopter has 16 rotor blades arranged in a circle above the passenger cabin, while the rotor blades for "Ehang 216" from China are beneath the cabin. Airbus' flying taxi has a futuristic design with four large rings spaced evenly apart above the cabin, while the Lilium Jet operates with wings. The design variety of these and other projects is as inspiring as it is impressive. And definitely a challenge when it comes to materials. Carvalho is convinced: "The dynamic material stress in each of these applications will be completely different from that of airplanes or today's helicopters because air taxis will take off and land much more frequently." After all, the business model, especially for passenger traffic, is designed to handle as many daily flights as possible and to load quickly between flights.

The envisaged applications for air taxis are already impressively diverse. It is true that the image of the air taxi for passengers within large cities is what the talk centers around most often. But at the same time, concrete discussions on air taxi use in completely different situations is also taking place: Emergency doctors could reach remote areas more quickly, heavy loads could be transported, offshore drilling platforms could be supplied with material and personnel, and other air taxi manufacturers are focusing on regional transport from city to city. What all these ideas have in common is that they will eventually fly without pilots: Air taxis will be autonomous, controlled from a computer center. Guests will not be able to interfere with flight operations - because that would introduce the unpredictable risk of human error.

BREAKING THROUGH MENTAL BARRIERS

This in turn means that the industry must break through "mental barriers", namely the potentially uneasy feeling of passengers about losing control. How long it will take is still a question, this combination of customer acceptance, technical development and, last but not least, regulatory clarity. In Japan and Singapore, it is said that people would like to start with commercial flights in "two to three years", some providers are somewhat more cautious about the timing. This is becoming clear: An entire industry feels that it is about to take off. The vertical take-offs and landings promise to be space-saving, and the eVTOL has an added hidden but very desirable advantage: With electric power, they are significantly quieter than other flying machines. This aspect is influenced by the vehicle material: correctly planned, composite components can reduce noise from rotors and engines.

At the same time, the air taxi must be robust and able to cope with bird strikes and hailstorms, just like any aircraft. This is where it is an advantage for experts to continuously develop their composite part construction materials: "We worked in our labs and with customers to determine what the ideal ROHACELL® core for com-

posites of the future should look and perform like," says Carvalho. The answer is ROHACELL® HERO. A material that is just as robust as any of the ROHACELL® foam products, but with a special quality making it easy to visually detect impact damage when ROHACELL® HERO foam core is inside the finished part - a decisively helpful function for safety issues in aircraft construction. For example, „If a hailstone strikes, the flexible carbon outer skin usually springs back and the impact leaves no trace of the incident ever happening," Carvalho describes. "Damage visibility is a very important factor for aircraft manufacturers and operators. You need to be able to easily see any area with damage. When ROHACELL® HERO is used as a part's core, impact damage visibility with the naked eye is excellent."

This same critical eye toward pre-flight inspection applies to all flying equipment, including air taxis. Roth emphasizes that ROHACELL® from Evonik has experience, expertise and acceptance in the aerospace industry for many decades. Evonik's commitment to providing technical expertise and partnering with their customers as they develop new applications benefits the growing group of air taxi developers. "We are talking about a very dynamic, young market in which all those involved are constantly looking for innovative technologies and materials," Carvalho adds.

DECIDING ON THE RIGHT MATERIALS

Several air taxi prototypes have already made their maiden flights. However, they are still undergoing continuous development. Each model still must prove its suitability for use under real conditions - especially since it is still not entirely clear what those conditions will be. As expected, experts and society must first negotiate the rules. Then it will become clear which air taxis have the best mix of price, power and safety. And the right materials may just prove to be the most important secret ingredient.

Company information
Evonik is one of the world leaders in specialty chemicals. The company is active in more than 100 countries around the world and generated sales of €12.2 billion and an operating profit (adjusted EBITDA) of €1.91 billion in 2020. Evonik goes far beyond chemistry to create innovative, profitable and sustainable solutions for customers. More than 33,000 employees work together for a common purpose: We want to improve life today and tomorrow.

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